An Improved Method of Rearing Field-Collected Fruit Fly Larvae[1, 2]

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The relatively low and variable rate of survival of fruit fly larvae in field-infested fruits held in the insectary made it desirable to develop a rearing technique that would give more consistent and higher rates of survival and emergence of flies and parasites. The procedure described here has been used in our laboratory for more than a year and has proved itself superior to other methods in a number of respects.

Larvae are removed from the fruits and transferred to a Syracuse dish containing the rearing medium. For larvae of *Dacus dorsalis,* the medium used is blended papaya pulp with a small quantity of yeast added, while for *D. cucurbitae* the dish is filled with small pieces of pumpkin or squash. As many as 60 to 75 larvae are added to a dish. Each dish is placed in a special rearing jar made up as described below, and the jars are then stored in an incubator room at a temperature of 28° C.

Optimum humidity is important to pupal survival, particularly when incubation is employed, and to achieve this a specially designed rearing jar has been developed. One-pound wide-mouth jars 3½ inches by 3½ inches are prepared as follows. First, a number of wire bridges are made by bending a 9½-inch length of wire as shown in figure 1, the lengths of the seven segments being 1 inch, 2 inches, 1 inch, 1½ inches, 1 inch, 2 inches, and 1 inch in that order. An equal number of pieces of ⅜-inch rubber tubing are cut, each piece 1 inch in length. Then 150 cc. of coarse, dry sand is measured out into each jar, making a layer about ⅞ inch deep. A section of tubing is set on end in the sand about ⅛ inch in from the wall of the jar with at least three-fourths of its length projecting above the sand. Next, 60 cc. of coarse, dry sand, 60 cc. of plaster of Paris, and 30 cc. of water are mixed thoroughly and poured onto the sand in the jar. Finally a wire bridge is set in the plaster, leav- about ¾ inch exposed. After the plaster has set, the rubber tubing is removed and the sand is poured out through the hole in the floor. A large number of jars constructed in this manner have been in use for a year, and aside from a slight loosening of the floor in a few of them they have shown no marked deterioration.

When the jars are used, 20 to 25 cc. of a 0.5 per cent solution of copper acetate or copper sulfate fungicide is placed in the bottom of each jar, a cork is fitted in the hole, and 60 cc. of sand is poured onto the plaster floor. The Syracuse dish is set on the wire bridge, and the jar is covered

[1] Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Technical Paper No. 222.

[2] Our studies have centered chiefly around guava (*Psidium guajava*) and mango (*Mangifera indica*) infested by *Dacus dorsalis* Hendel and bittermelon (*Momordica balsamina*) infested by *Dacus cucurbitae* Coquillett.

with a fine-meshed cloth held tightly in place by rubber bands. An area about 1-inch square is ground onto the surface of the jar with a carborundum stone and information pertaining to the sample is penciled on this area. When medium and jar are prepared carefully, mishaps in rearing of the flies are rare. Ordinarily no attention is required from the time the jars are placed in the incubator room until the dead flies and parasites are removed for counting.

During the first nine months of 1950, 49,633[3] oriental fruit fly larvae were dissected from 7,099 guava fruits taken at permanent collecting areas on the island of Oahu. Of these larvae, a total of 40,870, or 82.3 per cent, pupated successfully and 37,718 flies and parasites were recovered. Emergence from the puparia was 92.3 per cent, and total survival from larva to adult was 76.0 per cent.

Data compiled from recoveries of flies from fruits held in the standard holding boxes during 1949 reveal that this method is far less efficient in terms of survival of pupae. From July to September of that year, 26,183 puparia were obtained, and these produced 15,000 flies and parasites, an emergence rate of only 57.3 per cent. Not only was pupal survival poor, but the percentages varied greatly from sample to sample. Data on larval mortality are not available but this was undoubtedly high.

Considerably better results are obtained with rearing funnels of the type used in the United States Department of Agriculture fruit fly investigations.[4] In a comparative study made in our laboratory, seven lots of fruit were held in funnels, while duplicate lots were dissected and the larvae removed to the standard papaya medium. The data shown

[3] A large number of these larvae were held in paper tubs containing about ¾ inch of moistened fine sawdust which served to provide favorable humidity conditions and a place for the larvae to pupate. The paper tubs functioned in essentially the same manner as the jars and survival of larvae and puparia in each type of container was about the same.

[4] In the rearing funnels, the excess fruit juices are caught in a trap, and as a result pupal survival is much higher than in the holding boxes, since the sand does not become saturated, and fungi are reduced.

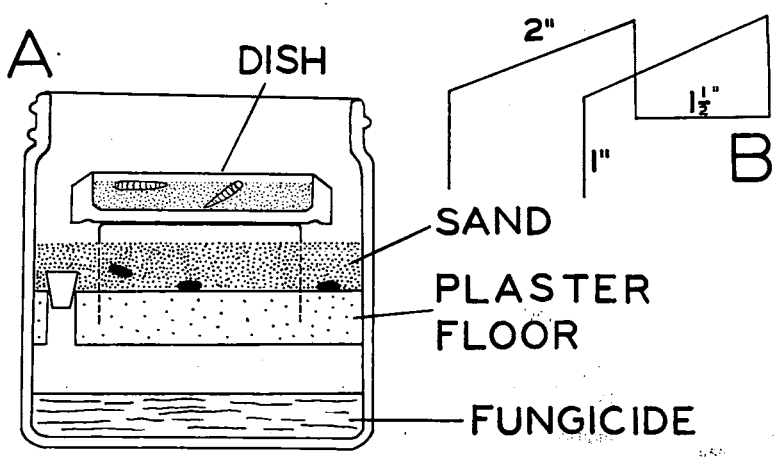

Fig. 1. A. Sectional diagram of rearing jar. See discussion in text. **B.** Diagram of wire bridge used to support rearing dish.

in Table 1 indicate clearly that survival of the dissected larvae was much better than of those held in the fruit. Actually, pupation was probably less than 40 per cent because the real number of larvae in these fruits must have been more than 3,612. On the basis of studies made by the writers, from 10 to 15 per cent of the larvae in the fruits are missed in the process of dissection. It would probably be safe to assume that the actual number of larvae in these fruits was approximately 4,000 and accordingly, survival of larvae in the fruits held in funnels would be only about 32 per cent.

Table 1.—Larval and pupal survival in duplicate samples of guavas dissected (D) and held in funnels (F).

	Number Fruits	Number Larvae	Number Puparia	Number Adults	Per cent Pupation	Per cent Emerg.	Per cent Survival	Per cent Parasit.
D	175	3,612	2,861	2,601	79.2	91.0	72.0	36.5
F	175	3,612*	1,588	1,296	44.0	81.6	35.9	38.5

* Estimated to be the same as in the dissected series.

In certain studies where maximum precision in determining the larval population is required, the fruits may be held in pans after the initial dissection and checked daily until no more larvae are found. This practice has not been followed in the parasite recovery investigations because it has been felt that the number of larvae missed has been constant enough that there was no effect on the conclusions reached.

As shown in the last column of Table 1, the two methods compared very favorably on the basis of percentage of parasitism. It is probable, however, that the dissection method gives more reliable results when the infestation is low or when only small samples of fruit are available.

During the last ten months of 1950, 19,136 larvae of *D. cucurbitae* were also reared by the method described above. Of these, 17,027 (89.9 per cent) pupated, and 16,302 produced parasites or flies. The rate of emergence was 95.7 per cent, and the total survival from larva to adult was 85.1 per cent. These larvae were obtained from *Momordica*. The rates of pupation, emergence, and survival were higher than those obtained with *D. dorsalis*, because the larvae in *Momordica* are less subject to asphyxiation or drowning than those in guava, and furthermore, *D. cucurbitae* probably is inherently a sturdier species than *D. dorsalis*.

The major disadvantage of the dissection holding method is the initial work involved in transferring the larvae from the fruits to the new food medium. However, that shortcoming is greatly overshadowed by the many advantages. Among the benefits derived are: (1) space conservation, (2) ease of handling, (3) elimination of harmful and competing organisms, (4) elimination of excessive moisture and control of humidity, (5) higher larval survival and higher and more uniform percentages of emergence from the puparia, (6) more rapid and uniform rate of development of the flies and parasites, and (7) reduction of obnoxious odors and *Drosophila* in the insectary.